



**Research Report 2016**

**Developing Air Defense Artillery Warrant Officers'  
Cognitive Skills: An Analysis of Training Needs**

**Gary M. Stallings  
Sean Normand**

Northrop Grumman Corporation

**Thomas Rhett Graves  
Louis Miller**

U.S. Army Research Institute

**Dana Fike  
Linda Brent**  
ASTA Group

**February 2018**

**United States Army Research Institute  
for the Behavioral and Social Sciences**

Approved for public release; distribution is unlimited.

**U.S. Army Research Institute  
for the Behavioral and Social Sciences**

**Department of the Army  
Deputy Chief of Staff, G1**

**Authorized and approved:**

**MICHELLE SAMS, Ph.D.  
Director**

---

Research accomplished under contract  
for the Department of the Army by

Northrop Grumman Corporation

Technical Review by

Jean Dyer, Columbus State University and Consortium Research Fellows Program  
Jennifer Tucker, U.S. Army Research Institute  
Jayne Allen, U.S. Army Research Institute

**NOTICES**

**DISTRIBUTION:** This Research Report has been submitted to the Defense Technical Information Center (DTIC). Address correspondence concerning ARI reports to: U.S. Army Research Institute for the Behavioral and Social Sciences, Attn: DAPE-ARI-ZXM, 6000 6th Street (Building 1461/Mail Stop: 5610), Fort Belvoir, VA 22060-5610.

**FINAL DISPOSITION:** Destroy this Research Report when it is no longer needed. Do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

**NOTE:** The findings in this Research Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

<b>REPORT DOCUMENTATION PAGE</b>			<i>Form Approved OMB No. 0704-0188</i>		
<b>1. REPORT DATE (DD-MM-YYYY)</b> February 2018	<b>2. REPORT TYPE</b> Interim		<b>3. DATES COVERED (From - To)</b> September 2016 – September 2018		
<b>4. TITLE AND SUBTITLE</b>  Developing Air Defense Artillery Warrant Officers' Cognitive Skills: An Analysis of Training Needs			<b>5a. CONTRACT NUMBER</b> W911NF-16-F-0029		
			<b>5b. GRANT NUMBER</b>		
			<b>5c. PROGRAM ELEMENT NUMBER</b> 633007		
<b>6. AUTHOR(S)</b>  Stallings, Gary M.; Normand, Sean; Graves, Thomas R.; Miller, Louis; Fike, Dana; Brent, Linda			<b>5d. PROJECT NUMBER</b> A792		
			<b>5e. TASK NUMBER</b> 409		
			<b>5f. WORK UNIT NUMBER</b>		
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b>  Northrop Grumman Corporation 3565 Macon Road Columbus, GA 31907			<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>		
<b>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b>  U. S. Army Research Institute for the Behavioral & Social Sciences 6000 6 <sup>TH</sup> Street (Bldg. 1464 / Mail Stop 5610) Fort Belvoir, VA 22060-5610			<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b> ARI		
			<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b> Research Report 2016		
<b>12. DISTRIBUTION/AVAILABILITY STATEMENT:</b> Approved for public release; distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b> ARI Research POC: Thomas Rhett Graves, Ph.D.; Fort Benning Research Unit					
<b>14. ABSTRACT</b>  This is the first of two reports on a research project intended to determine the cognitive skills required throughout the career of an Air Defense Artillery (ADA) Warrant Officer (WO) and whether the training they receive supports those requirements. The researchers assessed ADA WOs needs based on requirements for successful duty performance and compared these findings to the training WOs receive in formal courses during their career progression. Findings indicated differing requirements for WOs as they progress in their careers and between two ADA WO career paths (140A and 140E). On average across ranks, 17% of WOs reported working in duty positions above their grade indicating a need for skill development throughout their career progression, but especially critical in the junior level WO courses. Recommendations are provided to address identified gaps between the cognitive skills required by grade and duty position, and the common core training WOs traditionally receive prior to promotion.					
<b>15. SUBJECT TERMS</b> Air Defense Artillery Warrant Officers; Cognitive Skills Training; Cognitive Skills Development by Grade/Rank					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>	<b>18. NUMBER OF PAGES</b> 25	<b>19a. NAME OF RESPONSIBLE PERSON</b> Thomas Rhett Graves
<b>a. REPORT</b> Unclassified	<b>b. ABSTRACT</b> Unclassified	<b>c. THIS PAGE</b> Unclassified	Unlimited Unclassified		<b>19b. TELEPHONE NUMBER</b> 706-545- 2356



**Research Report 2016**

**Developing Air Defense Artillery Warrant Officers'  
Cognitive Skills: An Analysis of Training Needs**

**Gary M. Stallings  
Sean Normand**  
Northrop Grumman Corporation

**Thomas Rhett Graves  
Louis Miller**  
U.S. Army Research Institute

**Dana Fike  
Linda Brent**  
ASTA Group

**Fort Benning Research Unit  
Scott E. Graham, Chief**

**United States Army Research Institute  
for the Behavioral and Social Sciences**

**February 2018**

---

Approved for public release; distribution is unlimited.

## ACKNOWLEDGMENT

---

We would like to thank the many U.S. Army Air Defense Artillery subject matter experts who contributed to this research, including the military and civilian personnel at the Air Defense School, Fort Sill, OK, the Drive-Up Simulation Trainer (DUST) facility at Fort Bliss, TX, and Patriot unit trainers at Fort Hood, TX. The hospitality and professionalism we experienced and expertise provided by the Air Defense community during this research effort was exceptional. In addition, we would like to thank CW5 Chris Wehmeier, CW5 Stacy McNeil, and COL Jim Payne for their interest in and ongoing support of this research.

# DEVELOPING AIR DEFENSE ARTILLERY WARRANT OFFICERS' COGNITIVE SKILLS: AN ANALYSIS OF TRAINING NEEDS

## EXECUTIVE SUMMARY

---

### Research Requirement:

The success of the Air Defense Artillery (ADA) mission depends on experts to execute increasingly complex tasks as they advance in duties and responsibilities. ADA Warrant Officers (WOs) are critical personnel in the chain of experts executing those tasks. To be successful, WOs rely on cognitive skills that are developed and reinforced on a foundation of operational and training experiences. This research project identified how these requisite cognitive skills are developed and sustained as well as potential gaps in WOs' cognitive skills training and experience. Potentially, training gaps may limit the development of critical cognitive skills of lower ranking WOs. Without early career training and experiences to develop WOs' cognitive skills, additional challenges may arise as they progress in their careers when learning to carry out more complex and demanding duties in positions of increased responsibility. Without structured assessments, the lack of development of these skills could go unnoticed until a critical situation or need arises.

### Procedure:

We assessed the cognitive skill needs of ADA WOs based on requirements for successful duty performance. Researchers collected data from three ADA units including the ADA School and the 31<sup>st</sup> ADA BDE at Ft. Sill, OK, and the 11<sup>th</sup> ADA BDE at Ft. Bliss, TX. Data were representative of ADA WOs from newly assigned WO1s through well-seasoned CW4s in the 140A and 140E WO military occupational specialties (MOSs). The data provided information on previous and current duty assignments and the cognitive demands associated with performing those duties. Data from 59 participants were collected using questionnaires and open-ended interviews.

### Findings:

Findings indicate that WO1 140A, Command and Control Systems Integrators, and 140E, Air and Missile Defense (AMD) System Tacticians/Technicians are largely concerned with routine daily planning and decision-making operations. Mid-grade 140A CW2 personnel show a greater need for cognitive skills related to management and planning tasks while 140E mid-grade CW2 personnel tend to require management and decision-making skills. Both 140A and 140E CW3 and CW4 personnel show a marked increase in the need for skills required in either planning or the combination of planning and predicting. Findings indicate that while decision-making, planning, and predicting are all required cognitive skills for ADA WOs, decision-making and planning skills are the most prevalent.

A comparative analysis identified three potential gaps between the cognitive skill requirements ADA WOs need in their duty positions and the level of cognitive skill development

found in WO formal education. First, current instruction develops cognitive skills required at grade level; however, by shifting focus beyond current minimums, the schoolhouse can begin preparing WOs for more advanced cognitive tasks earlier and better equip them for follow-on assignments. Second, while formal education may prepare WOs for their current grade, on average 17% of ADA WOs reported working in assignments above grade. Third, instructors may have additional opportunities to apply instructional skills that foster critical thinking and cognitive development.

#### Utilization and Dissemination of Findings:

Senior leaders at the Air Defense Artillery School, Ft. Sill, OK were briefed on findings and recommendations on 6 August 2017. This research will also be used in developing measurement tools that ADA WOs may use to compare their cognitive skill development to those of their peers and higher-ranking WOs, providing a means for them to target cognitive skills for professional development.



DEVELOPING AIR DEFENSE ARTILLERY WARRANT OFFICERS' COGNITIVE SKILLS:  
AN ANALYSIS OF TRAINING NEEDS

CONTENTS

---

	Page
INTRODUCTION .....	1
ADA Warrant Officer Task Requirements .....	2
Problem Definition .....	3
METHOD .....	4
Cognitive Skills Requirements Analysis .....	4
Training Summary Analysis .....	9
Training Gap Analysis .....	14
RESULTS .....	14
Cognitive Skills Requirements .....	14
Training Summary .....	18
Training Gap Analysis .....	20
DISCUSSION .....	21
Recommendations .....	21
REFERENCES .....	23
ACRONYMS .....	25
APPENDIX A. DATA COLLECTION PROTOCOLS .....	A-1
APPENDIX B. COGNITIVE SKILL REQUIREMENTS RESULTS .....	B-1
APPENDIX D. TRAINING SUMMARY RESULTS .....	C-1

LIST OF TABLES

TABLE 1. SURVEY PARTICIPANTS .....	6
TABLE 2. CRITICAL COGNITIVE SKILLS .....	9
TABLE 3. FORMAL ADA WO COURSES .....	10
TABLE 4. 140A & 140E SURVEY RESULTS: CRITICAL COGNITIVE SKILLS REQUIRED BY GRADE .....	15
TABLE 5. 140A SURVEY RESULTS: CRITICAL COGNITIVE SKILLS REQUIRED BY GRADE .....	16

DEVELOPING AIR DEFENSE ARTILLERY WARRANT OFFICERS' COGNITIVE SKILLS:  
AN ANALYSIS OF TRAINING NEEDS

CONTENTS (continued)

---

	Page
TABLE 6. 140E SURVEY RESULTS: CRITICAL COGNITIVE SKILLS REQUIRED BY GRADE.....	17

LIST OF FIGURES

FIGURE 1. DUTIES PERFORMED "AT" AND "ABOVE" GRADE. ....	18
FIGURE 2. TRAINING FOSTERING COGNITIVE SKILL DEVELOPMENT.....	19
FIGURE 3. MOI FOSTERING COGNITIVE SKILL DEVELOPMENT.....	20

# **Developing Air Defense Artillery Warrant Officers' Cognitive Skills: An Analysis of Training Needs**

## **Introduction**

Air Defense Artillery (ADA) Warrant Officers (WOs) are technical and tactical experts who execute complex tasks. These tasks require professional confidence and complex cognitive skills developed through hard-won tactical experience as well as technical and operational training and education. Consider the following description:

Warrant officers, as the Army's premier land force technical experts and systems integrators, will be expected to provide expedient solutions to increasingly complex problems. In their unique roles, warrant officers must possess the deep knowledge and technical expertise to integrate systems throughout the force, and be able to develop innovative methods to support future requirements. This will require a greater investment to fully develop the knowledge, skills, and abilities of every warrant officer to reach their unique potential as Trusted Army Professionals. (U.S. Department of the Army, 2016, p. 4)

The ADA School at Fort Sill, OK, and the Warrant Officer School at Fort Rucker, AL, deliver a variety of residential courses to ADA WOs, providing WOs with the skills necessary to perform their duties and address complex technical problems. That said, these schools might only partially prepare WOs with the cognitive skills required for their follow-on assignments. WOs often develop these skills through informal training and education such as on-the-job-training, self-motivated research, and by seeking guidance from WOs who already possess the requisite skills. This report presents: (a) results identifying the critical cognitive skills required of ADA WOs to successfully perform their duties and progress in their career, (b) an evaluation of how cognitive skills may be developed through formal education and training provided by the ADA WOs professional military education (PME), and (c) a summary of gaps between cognitive skill training provided and required for successful duty performance as well as recommendations for mitigating identified gaps.

ARI research from 2016 examining ADA Warrant Officers (140A and 140E) duties and training provided that ADA WOs routinely perform tasks that involve decision making, planning, and predicting (Blue, Graves, & Cobb, 2016). These are the top three skills associated with higher-order thinking as identified in previous ARI ADA research (Stallings, Graves, & Blankenbeckler, 2017). As an example, Air Defense Artillery (ADA) crews are often faced with ambiguous situations in which they must exercise these higher-order thinking skills to interpret visual and audio signals, make sense of their environment, and perform the tasks associated with Air and Missile Defense (AMD) missions. To develop the complex cognitive skills needed at the senior levels, ADA WOs must continually develop these skills. Development of decision making, planning, and predicting skills supports grade/position requirements and professional growth across a career-long continuum (TRADOC, 2017).

## **ADA Warrant Officer Task Requirements**

ADA WOs are a valuable but limited resource within the ADA community. They serve as both technical and tactical experts in an area of increasingly complex systems, command and control structures, and nodes in the “kill chain.” In every maneuver brigade (BDE) combat team there exists an Air Defense and Airspace Management (ADAM) cell for which a single 140A warrant officer is authorized. This warrant officer, either a Warrant Officer 1 (WO1) or Chief Warrant Officer 2 (CW2), serves as primary communication systems integrator and is responsible for establishing, integrating, and maintaining all of the ADAM cell voice and data communications network architecture. As such, this warrant officer oversees the network and automation management, information security, and connectivity to the air battle command system, the brigade combat team local area network (LAN) and wide area network (WAN), lower and upper tier tactical Internet, mobile subscriber equipment, brigade subscriber node, Joint Tactical Information Distribution System, and Joint Data Network.

Further, this 140A WO coordinates and works closely with the higher headquarters G-6, the BCT, adjacent S-6s, and the supporting Signal Company to monitor network performance and database configuration and plans system reconfigurations caused by changes in the tactical situation, communications connectivity, and system initialization. He or she ensures situational awareness of the third dimension (i.e., air space) to the brigade combat team tactical operations center, advising the Brigade Commander and Staff. When all links are active/operational, this warrant officer assists in the performance of Assistant Division Air Defense Officer duties. The communications system integrator has the enormous job of ensuring the ADAM cell remains operational at all times. Additionally, this position demands requires certification as a joint interface control officer. These personnel and the systems and structures that they operate and supervise are vital to protecting U.S. and coalition forces from an increasingly sophisticated air and missile threats.

The ADA mission depends on 140A and 140E ADA WOs to execute increasingly complex tasks over the course of their careers. The 140A command and control integrators are responsible for supervising, planning, maintaining, managing, and coordinating all joint data-link operations and Command, Control, Communications, Computers, and Intelligence (C4I) systems training associated with forward area air defense including:

- Phased-Array Radar to Intercept on Target (Patriot) and Terminal High-Altitude Air Defense (THAAD) command posts and tactical control systems (battalion level – WO1/CW2; brigade level – CW3; Air and Missile Defense Command–CW4)
- Air Missile Defense Planning Control System ADAM cells (corps level - CW3/4; division level - CW3/4; and brigade-level - WO1/CW2)
- Joint Tactical Ground Station, with ancillary equipment.

The 140A WOs are responsible for coordinating the activities of enhanced operators for the maintenance of computers, commercial off the shelf and common hardware and software including ancillary equipment. They provide estimates of repair and repair priorities based on fix or fight criteria and availability of required assets. They advise commanders and staffs on

system employment options, capabilities, and configuration management for all Army Air and Missile Defense (AMD) command and control systems. They are responsible for materiel reporting and readiness, system employment, and crew certifications. Additionally, they may act as instructors for Soldiers, NCOs, other warrant officers and commissioned officers, teaching the necessary tasks of employing assets and adapting the software that best supports Army and AMD command and control doctrine. They analyze and interpret data employed in the communications architecture for a joint theater to support immature or sustained operations with the C4I assets on hand, and when necessary, serve as a detachment or battery commander. They may serve as the Army track data coordinator for the regional area AMD coordinator, and the regional interface control officer. Daily duties may include configuration management for the Air Missile Defense Planning Control System, including ancillary equipment. Additionally, they may serve as data-link managers providing prioritization and standard operating procedures for joint interoperability. They may also serve in other nominative positions Army wide, with duties as instructors, career managers, or in staff positions.

The 140E AMD System tactician/technician may serve as subject matter experts on the employment and operations of AMD systems performing duties such as tactical control officer (TCO) (WO1/CW2) at the battery level, tactical director (TD) (CW3) at the battalion level, battalion/brigade AMD system standardization officer (CW3), and ADA fire control officer at the ADA brigade (CW3/4) and AAMDC levels (CW4). They monitor/identify aircraft according to established procedures, initiate and monitor engagements of threat aircraft and missiles, and plan/develop air and missile defense designs in support of assigned/contingency missions. They advise the commander on capabilities and limitations of the AMD system. They supervise maintenance of equipment in AMD units as well as monitor the AMD system and related support equipment to detect, diagnose, and repair operator error and system malfunctions. They serve as coaches, teachers, mentors, and evaluators for Soldiers in AMD system operating tactics, techniques, and procedures. They perform joint kill chain functions and maintenance procedures and use and care for special tools and support equipment within the auspices of the Army maintenance management system. Additionally, they evaluate the effectiveness of maintenance programs and tactical crew training. Uniquely, they monitor and coordinate installation of modifications of AMD systems, introduce and train new weapons and missiles, and software upgrades. These warrant officers implement proper safety and security procedures applicable to the operation and maintenance support to the AMD systems and advise the commander and staffs on all tactical and technical considerations at all levels of AMD and maneuver unit command.

## **Problem Definition**

ADA WOs rely on cognitive skills that are developed and reinforced on a foundation of training and operational experiences. Identifying how these requisite skills are developed and sustained is vital in determining if any gaps exist in training and experience. Training shortfalls may limit the development of these skills for lower ranking WOs. Lack of training and experience in lower ranks may increase the challenges faced by WOs who carry out increasingly complex and demanding duties at higher ranks. Additionally, without structured assessments, the lack of development of these skills could go unnoticed until a critical situation arises.

By developing cognitive skills earlier in their careers, ADA WOs would be better prepared to carry out more complex responsibilities at higher ranks. In this research, we focused on identifying (a) the critical cognitive skills required for ADA WOs at each rank and (b) training impediments that may hinder the development of those skills. We also made actionable recommendations for mitigating those gaps.

We executed this research in three parts. First, we identified the critical cognitive skills that enable ADA WOs to be successful as they progress in their careers. Second, we examined how and when those cognitive skills are currently developed, reinforced, and assessed (if at all). Finally, we identified gaps between the cognitive skills required and the training needed to enable the development of those skills. Based on this research, we will develop a cognitive skills assessment tool for ADA WOs to identify their cognitive skill professional development needs at various points in their careers.<sup>1</sup>

## **Method**

The research method to identify potential gaps in the cognitive skill training for ADA WOs consisted of the following:

- A questionnaire was administered to WOs to identify existing cognitive skill requirements from Warrant Officer 1 (WO1) through Chief Warrant Officer 4 (CW4),
- The lesson activities and methods of instruction in existing ADA WO courses were examined to identify relevant cognitive skill training, and
- The cognitive skill requirements were compared to the courses to identify gaps.

## **Cognitive Skills Requirements Analysis**

There is currently no Army specification of ADA WOs cognitive skill requirements. Speaking generally, some Army doctrine specifies a need for higher-order cognitive skills for Soldiers. However, there is no specific statement concerning cognitive skill requirements. For example, U.S. Army Training and Doctrine Command (TRADOC) Pamphlet (Pam) 525-3-7-01 states that “The future OE [operational environment] will continue to demand competence on complex cognitive tasks from younger, less experienced officers and NCOs” (2008, p. 115). Doctrine has not specified the cognitive skills to target and to what degree the Army should develop these skills for particular MOSs and ranks within a career trajectory. The requirements analysis identified critical cognitive skills needed for all ADA WOs by grade, including WO1 through Chief Warrant Officer 4 (CW4). There were too few WOs ranked Chief Warrant Officer 5 (CW5) in the sample to make determinations about this group.

**Considerations.** To identify requirements, we relied on the ranks in the table of organization and equipment (TO&E) for ADA units. The TO&E, we assumed, would be a determining factor for the WOs’ position at a particular rank. In other words, rank authorizations to fill a particular ADA WO position should determine the cognitive skill requirements for that position, regardless of the actual rank of WOs who have filled that position. By determining

---

<sup>1</sup> This tool will be presented in a subsequent ARI research report.

requirements using rank authorizations, we did not need an up-front analysis of shortage requirements across the ADA WO community. The intent was to collect data that reflected the requirements of each particular ADA WO rank. For example, during data collection, when a CW3 was assigned to a CW4 position, we assumed the CW3's responses to the questionnaire reflected the cognitive requirements for that position (i.e., CW4). After the data collection was complete, the team examined how often participants were assigned positions typically allocated to higher-ranking WOs.

**Participants.** The ADA WO population is small, which limited our sample size. To compensate, we asked participants to provide information for both their current rank and duty position as well as past WO ranks and duty positions. Examining past ranks and duty positions allowed us to collect additional data points, capturing information about early to mid-career WO cognitive skill requirements.

The ADA WO community consists of two main MOSs: 140A and 140E. The 140A is a Command and Control Systems Integrator and the 140E, an AMD System Tactician/Technician. In 2017, the 140E MOS split into two MOSs, consisting of tacticians (140K) and technicians (140L). Since this research gathered data on both current and former ADA WO experiences, the 140E split was not included in our analysis.

We collected data from three ADA units, including the ADA School and the 31<sup>st</sup> ADA BDE at Fort Sill, OK and the 11<sup>th</sup> ADA BDE at Fort Bliss, TX. Out of the approximately 365 ADA WOs currently in ADA, a total of 61 participants participated in the survey. Of those 61, two participants had MOSs not germane to the research effort (i.e., 915A automotive maintenance, 948D electronic maintenance); thus, these data were excluded. The remaining 59 participants represent 16% of the WOs in the ADA branch. Only a few senior CW4 and no CW5 ADA WOs were available. Survey results were limited to responses from WO1s through CW4s. To provide additional detail and data points, we asked WOs to reflect on the cognitive skills needed in their current position, as well as their two previous assignments, which resulted in 246 task category responses. After removing incomplete entries, the research team had a total of 210 usable cases for analysis. All data, including data on past ranks and duties, were included in the analysis. Table 1 breaks down the number of participants by unit, grade, and MOS.

Table 1  
*Survey Participants*

Location	Unit	Personnel	Participants	Grade	MOS
Ft. Sill	30 <sup>th</sup> ADA BDE (ADA School)	140A & 140E (Basic Course)	18	WO1 - 18	140A - 7 140E/Tech - 4 140E/Tact/Tech - 7
Ft. Sill	30 <sup>th</sup> ADA BDE (ADA School)	140A & 140E (Advanced Course)	19	CW3 - 1 CW2 - 18	140A - 9 140E/Tact - 5 140E/Tech - 3 140E/Tact/Tech - 2
Ft. Sill	30 <sup>th</sup> ADA BDE (ADA School)	140A & 140E (Instructors)	5	CW4 - 2 CW3 - 2 CW2 - 1	140A - 2 140E/Tact - 3
Ft. Sill	31 <sup>st</sup> ADA BDE	140A & 140E	7	CW4 - 3 CW3 - 3 CW2 - 1	140A - 2 140E/Tact - 4 140E/Tech - 1
Ft. Bliss	11 <sup>th</sup> ADA BDE	140A & 140E	10	CW3 - 6 CW2 - 2 WO1 - 2	140A - 3 140E/Tact - 4 140E/Tech - 3
Total				WO1 - 20 CW2 - 22 CW3 - 12 CW4 - 5	140A - 23 140E/Tech - 11 140E/Tact - 16 140E/Tact/Tech - 9

**Data collection and procedures.** We assessed ADA WOs' cognitive skill needs in terms of what is required for success as rank and duty responsibilities increase across their careers. The data focused on previous and current duty assignments and the cognitive skills associated with those duties. Prior to the data collection, we briefed participants on their rights as participants in research, including their right to withdraw participation at any time without repercussion. Following this, we provided informed consent forms to the group and collected signatures to confirm that participants understood the purpose of the research and their rights as participants. Next, we described each of the form's sections and showed participants where to find clarifying definitions of section contents. The research team provided participants as much time as necessary to complete the forms. After the consent forms and instructions were complete, we administered the questionnaires and followed-up with focus group discussions. The researchers ensured participants answered all questions completely, then collected the forms and entered the data into a database.

**Questionnaire.** To identify the critical cognitive skills associated with WO positions, a questionnaire was administered that included both forced-choice and open-ended items. We asked WOs to identify task categories critical to performance in their position and then the corresponding critical cognitive skills used to conduct the tasks within those categories. After



participants had completed their questionnaires, the researchers guided focus group discussions using an interview protocol (See Appendix A for the data collection forms).

On the questionnaires, participants reported their current and former duty assignments. We asked for information on their three current and most recent duty assignments as an ADA WO, given the following parameters:

- All duty assignments within the last 5 years;
- Excluding those designated as “Broadening Assignments.”

Participants only completed the questionnaire for applicable assignments.

*Demographic data.* For each duty position, we collected demographic data regarding MOS, rank, authorized rank for the specified position, time in position, and level of position held to facilitate analysis from different perspectives.

*Task categories.* For each duty position they listed, participants selected two task categories they viewed as most critical to performance in that position. WOs were limited to selecting two task categories per duty position in order to support data collection within the time available. While ADA WOs perform a variety of specific duties, we categorized WO duties into several groups of similar tasks to streamline data collection and analysis. For instance, we grouped ‘monitor and supervise operations of AMD weapons systems,’ ‘monitor and supervise unit maintenance of AMD weapons systems,’ and ‘supervise operations of unit diagnostic mandatory parts listing’ into a single category: ‘monitoring and supervising operations and/or personnel.’ Similarly, ‘advise staff officers on AMD weapons system capabilities and limitations,’ ‘provide leadership, guidance, and direction to Field Commanders up to and including Brigade levels,’ and ‘provide AMD weapons systems peculiar tactical/technical assistance to subordinate elements’ were grouped into ‘advising and providing expertise and/or providing leadership.’ Six task categories were determined by grouping similar tasks. They were:

- Monitoring and Supervising Operations and/or Personnel,
- Advising and Providing Expertise and/or Providing Leadership,
- Coordinating Activities and/or Managing Personnel or Resources,
- Conducting Operations and Implementing Procedures,
- Instructing/Training Personnel and/or Evaluating Operations, and
- Planning, Developing, and/or Organizing Operations and Policy/Procedures.

Previous ARI research from 2016 examining ADA Warrant Officers (140A and 140E) duties and training supported the grouping of task categories (Blue, Graves, & Cobb, 2016). Task categories were self-explanatory to ADA WOs.

The task categories listed on the survey helped frame participants’ examination of cognitive skills used in the performance of their duties. Participants selected the task category most critical to their performance in a particular duty position and subsequently answered follow-on questions about the cognitive skills used for those tasks. They then selected the

second most critical task category for that same duty position and again answered questions about cognitive skills.

*Critical cognitive skills.* As noted, for each of the two task categories selected, participants then choose the cognitive skill they considered most critical to performing the tasks in that category. Three higher-order thinking skills were used (see Table 2): decision-making, planning, and predicting. Soldiers routinely practice these higher-order thinking skills across duty positions with varying levels of complexity and significance. For instance, compare a battalion electronics maintenance officer (EMO) responding to and prioritizing trouble calls with an ICC tactical director (TD) viewing the same situation. The first is responding to and prioritizing trouble calls, clearing a minor hazard on an expended launcher on one launcher and clearing a hazardous misfire condition on a second launcher with a full missile count. Based on system availability, the TD must make tactical decisions to assure continued protection of assets with the remaining operational resources that are mission ready and available. While both are making decisions, these decisions would have varied levels of complexity and potential long-term consequences.

Then participants identified an associated level of decision, plan, or prediction for each selection to better distinguish levels of complexity and significance. These levels were defined as 'routine daily,' 'management and supporting,' and 'long-range major.' Predicting was refined into 'short-term' and 'long-term' predictions. The descriptions and categories of critical cognitive skills in Table 2 clarified for participants each critical cognitive skill. This rating form is in Appendix A.

Table 2  
*Critical Cognitive Skills*

Critical Cognitive Skill		Description
Decision making	Routine daily	Routine choices for daily operations. Usually involve limited resources and short-term applications.
	Management and supporting	Choices on implementation and how to manage resources to achieve a goal. Usually have medium-term implications.
	Long-range major	Major choices of direction or actions. Usually complex and multidimensional with wide spread or long-term impact.
Planning	Routine daily	Routine planning that focuses on specific procedures, processes that support implementing higher level plans.
	Management and supporting	Planning that supports a strategic plan by translating it into specific plans relevant to a distinct area of an organization.
	Long-range major	Large scale planning of direction or actions that affect major organizations.
Predicting	Short-term	Largely based on known circumstances that currently exist and have short-term effects.
	Long-term	Largely based on unknown circumstances that may exist in the future and have long-term effects.

*Clarifying questions.* After participants rated each duty position, they answered five questions pertaining to that duty position. We used their answers to understand trends identified in the data (see Appendix A).

### **Training Summary Analysis**

The Army develops new or updated course curricula using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) learner-centric, five-phase instructional design model. This model focuses training developers on learning outcomes determined by learner needs. From the ADDIE process, elements within the design phase guide the development of course curricula including the necessary methods and techniques needed to develop higher-order cognitive skills if required.

**Objective.** The primary objective of the training analysis was to assess professional military education (PME) curricula content used for formal ADA WO courses to determine the level to which cognitive development is associated with each lesson. Of specific interest were those lessons that could develop higher-order cognitive skills.

**Considerations.** We did not execute a full training needs analysis, as access to the original requirements analysis used to develop the formal curricula was not available. Consequently, the research team focused on a lesson description analysis and a review of the

training methods prescribed in the curricula in relation to the development of higher order cognitive skills.

The 140E (Tactical/Technical) MOS split into two separate MOSs, 140K (Tactician) and 140L (Technician), late in 2017. The new curricula were developed subsequent to the data collected for this research and were not available for review at the time. The analysis relied on the content provided in the curriculum for the 140E courses.

**Selection of data sources.** To analyze current training, we focused on the formal courses ADA WOs attend as they progress through their career, excluding specialty courses. All ADA WOs are required to take these courses; therefore, they represent a baseline of knowledge and skills across the ADA WO community. A review of course documents suggested there was sufficient detail in the training materials to conduct an analysis on the potential development of higher order cognitive skills during training. Materials collected for this analysis were (a) education and training directives, (b) curricula development directives, (c) course curricula instructions, and (d) course lesson plans. Table 3 outlines the six courses selected for the analysis and shows the correspondence with WO rank.

Table 3  
*Formal ADA WO Courses*

Rank	MOS	Course Title	Acronym	Course Number
WO1	140A	Command and Control Systems Integrator	WOBC	4F-140A
	140E	Patriot System Technician	WOBC	4F-140E
CW2	140A	ADA WO Advance Course	WOAC	2-44-C32-140A
	140E	ADA WO Advance Course	WOAC	2-44-C32-140E
CW3/ CW4	140A/E	WO Intermediate Level Education	WOILE	1-250-C8
CW4/ CW5	140A/E	WO Senior Staff Education	WOSSE	1-250-C9

*Note:* WOBC = Warrant Officer Basic Course; WOAC = Warrant Officer Advanced Course; WOILE = Warrant Officer Intermediate Level Education; WOSSE = Warrant Officer Senior Service Education.

**Resource materials.** The primary data source used during the evaluation were the course curricula POIs. POIs are documents that contain the curricula descriptions in the form of lesson titles, actions, conditions, and standards. The POIs for each course in the ADA WO PME continuum were obtained from the United States Army Training Development Capability website. In addition to the condition and standards, POIs also provide information regarding the MOIs used and time spent on each activity within the lesson. The research team supplemented the primary data with supplemental data from Department of the Army Pamphlets (DA PAM) and publications from the U.S. Army Training and Doctrine Command (TRADOC).

TRADOC is responsible for training and development policies and serves as the proponent for training and education development as identified in the *Army Training and Leader*

*Development Regulation 350-1* (U.S. Department of the Army, 2014b). This regulation provided additional overall guidance on TRADOC education and training responsibilities as well as warrant officer education requirements, which mirrored those identified in the DA PAM 600-3. The researchers obtained course development directives from the TRADOC administrative publications website in order to review learning objective development parameters and their contribution to learning of cognitive skills. The publications obtained for review were the *Army Educational Processes Pamphlet 350-70-7* (TRADOC Pamphlet 350-70-7; U.S. Department of the Army Training and Doctrine Command, 2013), the *Training Development in Support of the Operational Domain Pamphlet 350-70-1* (TRADOC Pamphlet 350-70-1; U.S. Department of the Army Training and Doctrine Command, 2012), and the *Training and Education Development in Support of the Institutional Domain Pamphlet* (TRADOC Pamphlet 350-70-14; U.S. Department of the Army Training and Doctrine Command, 2015). These pamphlets provided information on the Army's use of the ADDIE process in instructional system design.

A search of the Army Publishing Directorate (APD) website yielded education and training source documents identifying warrant officer training and education requirements as well as the command agencies responsible for training development. The source documents for training and education revealed that the Headquarters, U.S. Department of the Army is responsible for commissioned officer career development and management as identified in the *Commissioned Officer Professional Development and Career Management Pamphlet 600-3* (DA PAM 600-3; U.S. Department of the Army, 2014a). This document was particularly useful for this analysis because it served as a professional development guide for career development opportunities. This pamphlet identified warrant officer education and training requirements by grade and MOS, provided information on grade duty assignments and in-grade experience requirements, and provided follow-on scholastic options.

**Method.** A thorough examination of course materials was conducted to extract information pertaining to cognitive skill development. Lesson plan descriptions and training methods used, as outlined in the POIs, were analyzed to determine the degree to which each course may develop higher-order cognitive skills. Several components of the curricula were considered to address each curriculum's focus on cognitive skills. The primary POI components that contained relevant data included the lesson action text, the standards associated with the lesson, the breakdown of activities within the lesson, the MOIs associated with each activity, and the time spent on each activity. Standards were especially helpful as they established the expected training requirements and training outcomes for each lesson. In addition, activities within each lesson were examined to determine the degree to which each fostered the development of higher order cognitive skills.

Each lesson was examined to determine the degree to which higher-order cognitive skills would be developed. In doing so, each lesson action text and standards were examined together with the description of training and methods used to conduct the training. Evaluating these elements provided insight into what instructors expected of students and what the students could expect from the instruction.

**Lesson description analysis.** To determine how well the curricula fosters development of higher-order cognitive skills, an analysis was conducted of all the information provided for

individual lessons, particularly the learning objectives (LO) found in the POIs. LOs in POIs include a three-part statement of actions, conditions, and standards. The lesson descriptions were compared to the action verbs used in the lesson action text and standards, assuming that the text and standards would set the conditions of performance for the training.

Lesson action text and standards were constructed using action verbs to establish a performance-based action associated with instruction. With this in mind, the researchers examined lesson activities from each of the courses to determine the cognitive skill level according to the action verbs in conjunction with the lesson plan descriptions. As stipulated in the TRADOC Pamphlet 350-70-14 (2015) and TRADOC Pamphlet 350-70-7 (2012), LO cognitive skill level construction follows the structure of hierarchical learning identified in the cognitive domain of Bloom's revised taxonomy (Anderson et al., 2001). TRADOC Pamphlet 350-70-1 provides a verb list for LO development which is based on Bloom's taxonomy. TRADOC identified approved verbs using a classification of C1 through C6. Lower classifications, C1 through C3, indicate lower-order cognitive skills; higher classifications, C4 through C6, indicate higher-order cognitive skills.

Action verbs were reviewed first, then the complete lesson plan description. A review of the lesson plan description was necessary because the action verbs did not always depict the training in accordance with TRADOC Pamphlet 350-70-14 (2015). Researchers noted that the action verbs used in the descriptions appeared to be selected at the discretion of the POI developer. Consequently, verbs and their cognitive skill level may vary between POI developers. TRADOC Pamphlet 350-70-14 states that "though action verbs are an indication of the level of learning expected, look at the total behavioral statement (action, condition, and standard) in order to accurately determine the learning objective level because the same verb may appear in different levels of learning" (2015, p. 69). As such, complete lesson plan descriptions found in the LOs were used together with the action verbs to assign a cognitive skill level to each lesson or portion of a lesson where applicable, to all training within each course.

All lessons were coded C1 through C6 (see Appendix C) with the associated training time allocated for each. This categorization facilitated a subsequent analysis of the MOI by time and category. The researchers assembled these data at the lesson, module, and course level to provide a micro- and macro-view of the instruction that fosters higher-order cognitive skill development. Lessons designated as levels C4 through C6 were isolated to obtain the academic instruction time allocated to higher-order cognitive skill development. This process provided a percentage breakdown of time allocated to higher-order cognitive skill development by lesson, module, and course and revealed the total amount of time allocated to higher-order cognitive skill development.

In determining and assigning cognitive skill levels, each lesson plan from each of the POIs was reviewed, with attention to the Lesson Title, Action Text, Condition, and Standards. Three researchers conducted the evaluation, and each lesson plan was reviewed twice, once by a primary reviewer and once by a secondary reviewer. The group adjudicated any discrepancies between the primary and secondary reviewers prior to coding the level into the database. During the review, the researchers identified the verb used in the Action Text description and cross-referenced each verb used with Bloom's Taxonomy Verb/Cognitive level reference sheet. However, in certain circumstances, we noted that the verb used in the Action Text did not match

verbs used in the description of the published Standards. In these situations, we deferred to the standards to assist in adjudicating either an upgrade or downgrade in cognitive category level assignment.

For example, in the lesson titled “Integrate Historical Awareness and Critical Thinking skills,” the verb integrate is a C6 cognitive level verb. The Action Text states, “Apply knowledge of military history and battle analysis to the professional development of self and subordinate leaders.” The verb “apply” is categorized under cognitive level 3; however, the standards written for this lesson plan requires a student “selects the correct definition of military history, identify the purpose of military history study and list the 4 steps of battle analysis.” The verbs “select, identify, and list” within the published standards are all C-1 level verbs and thus do not match the cognitive demands of C3 “apply” or C6 “integrate.” In this case, researchers would downgrade this lesson’s cognitive level to C-1.

Similarly, the lesson plan within the 140A WOBC, 441-WBCAF115/3.0, the action text states “integrate the AN/PRC-117 Radio” “integrate” is a C6 level verb. However, in the standards, Soldiers must “Describe-C-1, Configure-C-3, Identify-C-1, Prepare-C-3, and Operate-C-3.” In this case, the researchers downgraded the lesson’s cognitive level to C-3.

***MOI analysis.*** MOIs are instructional methods used to support the delivery of instructional material and help students achieve the learning objectives. Learner-centric methods, regardless of the action verb level (i.e., C1-C6), are assumed to promote cognitive development better than instructor-centric methods. Instructor-based methods such as lectures and demonstrations are a passive means of delivering information and involve little student involvement or cognitive stimulation. Learner-centric methods such as practical exercises, discussions, and peer-partner learning are active means of information delivery and promote discovery-learning principles linked with cognitive development (Department of the Army [DA], 2015).

After matching course lessons to cognitive skill learning levels, the amount of time allocated to specific MOIs that foster cognitive skills development was calculated. TRADOC 350-70-14 served as a reference for determining Army approved MOIs for LO descriptions. Lesson activity descriptions were evaluated to ensure the proper MOI was attributed to the activities exercised in the learning environment.

The research team compiled the learner-centric MOIs (i.e., methods associated with higher-order cognitive skill development) for each course, then determined the percentage of academic learning hours for each MOI. This analysis provided a summary of MOIs that foster higher-order cognitive skill development by MOI, by course, and overall within ADA WO institutional training.

***Instructional skills and limitations.*** Instructional skills are training tools used by the instructor/trainer to help target the learning objectives. Specifically, they are instructional skills used by the trainer when delivering instruction to help direct training and foster critical thinking. Instructional training techniques can complement instruction with virtually any of the training methods chosen (e.g., facilitation combined with discussion). Techniques vary between individual instructors; lesson plans do not always document these variations. We found that

information contained in available training material was insufficient to determine the actual instructional skills used by individual instructors. One limitation of this effort was that we were unable to observe instruction directly; consequently, we used only MOIs to determine cognitive skill development levels. We acknowledge that the method stated in the MOI is not necessarily the delivery method utilized in the classroom; however, the official course documentation does speak to the intent for the lesson.

## **Training Gap Analysis**

**Approach.** The cognitive skill requirements analysis provided indications of what cognitive skills are required for ADA WOs by rank and by MOS. The training summary analysis provided information regarding the development of cognitive skills during formal training by rank and MOS. The training gap analysis compared the results of the requirements analysis to the results of the training analysis to determine any potential gaps between which cognitive skills are required at different ranks and which existing training may potentially develop.

## **Results**

### **Cognitive Skills Requirements**

The initial analysis for this project focused on determining cognitive skill requirements for ADA WOs by rank regardless of MOS. From the 59 participants included in this study, we analyzed 210 identified duties performed by WO1 through CW4 personnel.

**Requirements for both MOSs.** Survey results for both 140A and 140E WOs indicated that decision-making and planning were more critical to the execution of their assigned duties than predicting. However, the combined responses of 140A and 140E offered little distinction between decision making and planning. As expected, lower-ranking personnel tend to be concerned with routine daily and short-term operations while higher-ranking personnel tend to be concerned with management and supporting and long-term operations. While the combined levels of decision-making compared to the combined levels of planning for each rank indicated some difference in what participants deemed most critical, the greatest difference appeared at the CW4 level where participants rated planning much higher than decision-making. Table 4 presents the combined responses of both task categories chosen by participants.



Table 4  
*140A & 140E Survey Results: Critical Cognitive Skill Required by Grade*

Critical Cognitive Skill		WO1 (n = 26)	CW2 (n = 104)	CW3 (n = 56)	CW4 (n = 26)
Decision Making	Routine Daily	19%	23%	11%	17%
	Management & Supporting	23%	24%	23%	8%
	Long-Range Major	0%	6%	7%	4%
	Decision Making Total	42%	53%	41%	29%
Planning	Routine Daily	27%	14%	14%	13%
	Management & Supporting	12%	18%	29%	33%
	Long-Range Major	8%	3%	5%	13%
	Planning Total	46%	36%	48%	58%
Predicting	Short-Term	4%	7%	5%	0%
	Long-Term	8%	5%	5%	13%
	Predicting Total	12%	11%	11%	13%

*Note:* Rounding accounts for slight variation in total percentages reported.

Discussions with WOs provided researchers with a greater understanding of the types of duties performed by 140As and 140Es and suggested that cognitive requirements could vary by MOS as well. Information from these sources suggested that 140A personnel are largely concerned with planning and implementing connectivity of networks and communications for current and future operations while 140E personnel are more concerned with critical timely decision making while fighting the battle in air and missile defense. The researchers further examined participant responses filtered by MOS.

**Requirements for each MOS.** The analysis for each MOS (140A and 140E), showed that critical cognitive skills required by ADA WOs vary by Military Occupational Specialty (MOS) as well as by rank. Overall WO1 personnel showed a tendency toward performing routine daily decision making and planning regardless of MOS.

*Command and Control Systems Integrator (140A).* 140A WOs are network specialists concerned with ensuring that all communication between systems, decision makers, and supporting staff is connected and functioning properly. These personnel establish connectivity for current operations and subsequently monitor network status and plan for future operations. Outside of routine daily operations, lower- to mid-grade 140A WOs show a tendency toward planning for future events as shown in Table 5. Higher-ranking personnel show a tendency toward planning operations, including those with long-term effects.

Table 5  
*140A Survey Results: Critical Cognitive Skill Required by Grade*

Critical Cognitive Skill		WO1 (n = 6)	CW2 (n = 38)	CW3 (n = 14)	CW4 (n = 10)
Decision Making	Routine Daily	33%	18%	0%	20%
	Management & Supporting	17%	13%	29%	10%
	Long-Range Major	0%	13%	14%	0%
	Decision Making Total	50%	45%	43%	30%
Planning	Routine Daily	17%	16%	0%	10%
	Management & Supporting	17%	32%	43%	20%
	Long-Range Major	0%	3%	0%	20%
	Planning Total	33%	50%	43%	50%
Predicting	Short-Term	0%	3%	14%	0%
	Long-Term	17%	3%	0%	20%
	Predicting Total	17%	5%	14%	20%

*Note:* Rounding accounts for slight variation in total percentages reported.

*Air and Missile Defense (AMD) System Tactician/Technician (140E).* 140E WOs are technical and tactical specialists largely concerned with current operations of maintaining equipment and fighting the air battle. Cognitive skill requirements for 140E ADA WOs, both technical and tactical, focus on more immediate needs. Outside of routine daily operations, lower- to mid-grade 140E WOs are primarily concerned with immediate decision-making operations for current situations as depicted in Table 6. Higher-ranking personnel shift their focus to future planning for air battle operations.

Table 6  
*140E Survey Results: Critical Cognitive Skill Required by Grade*

Critical Cognitive Skill		WO1	CW2	CW3	CW4
Decision Making	Routine Daily	15%	26%	14%	14%
	Management & Supporting	25%	30%	21%	7%
	Long-Range Major	0%	2%	5%	7%
	Decision Making Total	40%	58%	40%	29%
Planning	Routine Daily	30%	14%	19%	14%
	Management & Supporting	10%	11%	24%	43%
	Long-Range Major	10%	3%	7%	7%
	Planning Total	50%	27%	50%	64%
Predicting	Short-Term	5%	9%	2%	0%
	Long-Term	5%	6%	7%	7%
	Predicting Total	10%	15%	10%	7%

*Note:* Rounding accounts for slight variation in total percentages reported.

*Additional cognitive skill requirements.* ADA WOs are in high demand but short supply; consequently, ADA WOs often fill a position while at a lower rank than is authorized for the position. When analyzing the demographic data, we found that 17% of ADA WOs reported being assigned to positions above grade (see Figure 1). This is an important consideration when determining the cognitive skills required for these individuals. Even when a Soldier fills a duty position at a lower rank than authorized for that position, the requirements of the duties remain the same and likewise the cognitive skills required to carry out those duties.

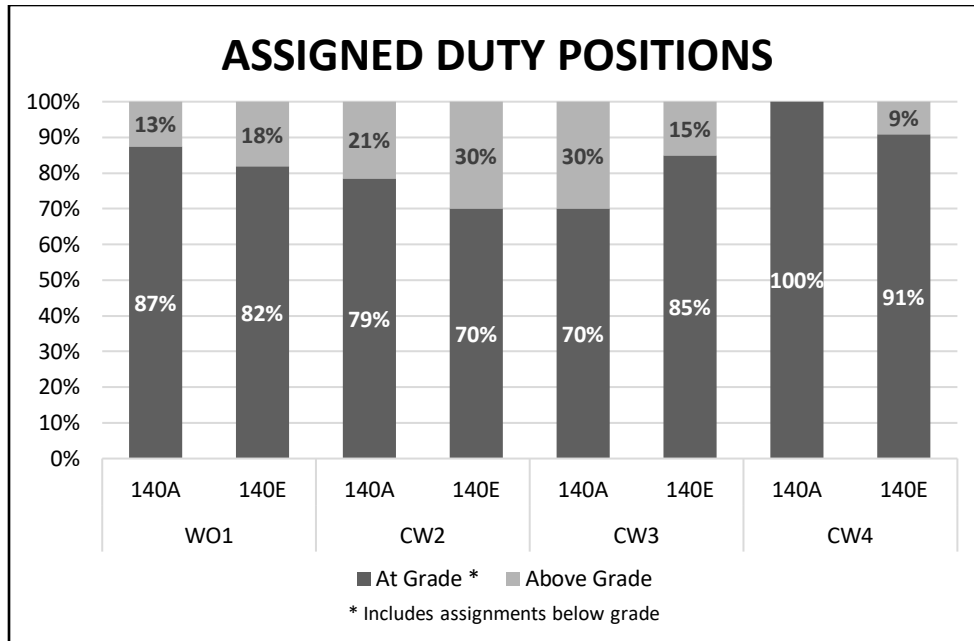


Figure 1. Duties performed “At” and “Above” grade.

**Cognitive skill requirement summary.** While decision-making, planning, and predicting are requirements for all ADA Warrant officers, decision making and planning are most prominent.

- Requirements for WO1s regardless of MOS are centered on routine daily decision-making and planning.
- Requirements for CW2 personnel:
  - 140A – Planning (mainly management and supporting)
  - 140E – Decision-making (split between routine daily and management and supporting)
- Requirements for CW3 personnel:
  - 140A – Planning (largely management and supporting)
  - 140E – Split between decision-making and planning
- Requirements for CW4 personnel:
  - 140A – Split between decision-making, planning, predicting
  - 140E – Planning (largely management and supporting)
- Approximately 17% of ADA WOs reported assignments to positions above grade and may require training on the cognitive skills necessary for performing those duties.

### Training Summary

ADA WO course module/lesson sequencing, as described in TRADOC Pamphlet 350-70-1 (2012), is organized in a “building block” structure with introductory courses providing the foundation for more advanced courses. All courses had POIs with learning objectives that described activities for individual lessons. The POIs provided ample information for an analysis of each lesson’s potential for fostering development of higher-order cognitive skills. The

following paragraphs present the results of our analyses of the combined courses. Appendix D provides details for individual courses.

**Cognitive skill development in training.** The lesson description analysis provided the amount of time allocated, by course, to activities that foster higher-order cognitive skill development. The percentage of time for each course is a reflection of time allocated to activities fostering higher-order cognitive skill development in relation to total academic learning time (total course time minus test and administration time). The analysis revealed that training which fosters cognitive skill development increases with courses associated with higher ranks. There is a shift in emphasis on cognitive skill activities from WOBC/WOAC to senior level, WOILE/WOSSE, courses (Figure 2). This shift indicates that the senior courses rely more heavily on lesson activities with C4 through C6 verbs when compared to the junior level courses.

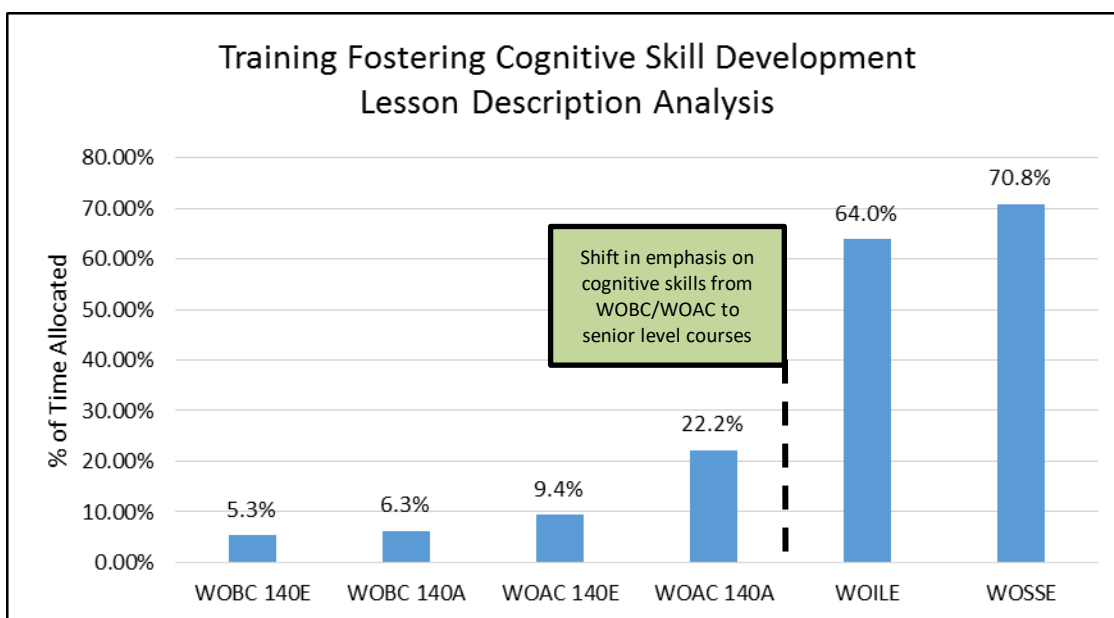


Figure 2. Training fostering cognitive skill development

**Use of specific MOIs.** We examined POIs to identify MOIs used in each lesson. Figure 3 depicts the MOIs that were associated with fostering development of critical thinking and cognitive skills across all courses combined. MOIs that were not associated with the development of higher-order thinking skills (e.g., lecture conference, demonstration) were filtered out of figure 3. Most MOIs used during instruction enhance cognitive skill development regardless of the lesson activity. For instance, the lesson activity could be a C1 through C3 verb, but the MOI used were associated with developing higher-order thinking skills. The analysis also indicated a predominant use of discussions and practical exercises.

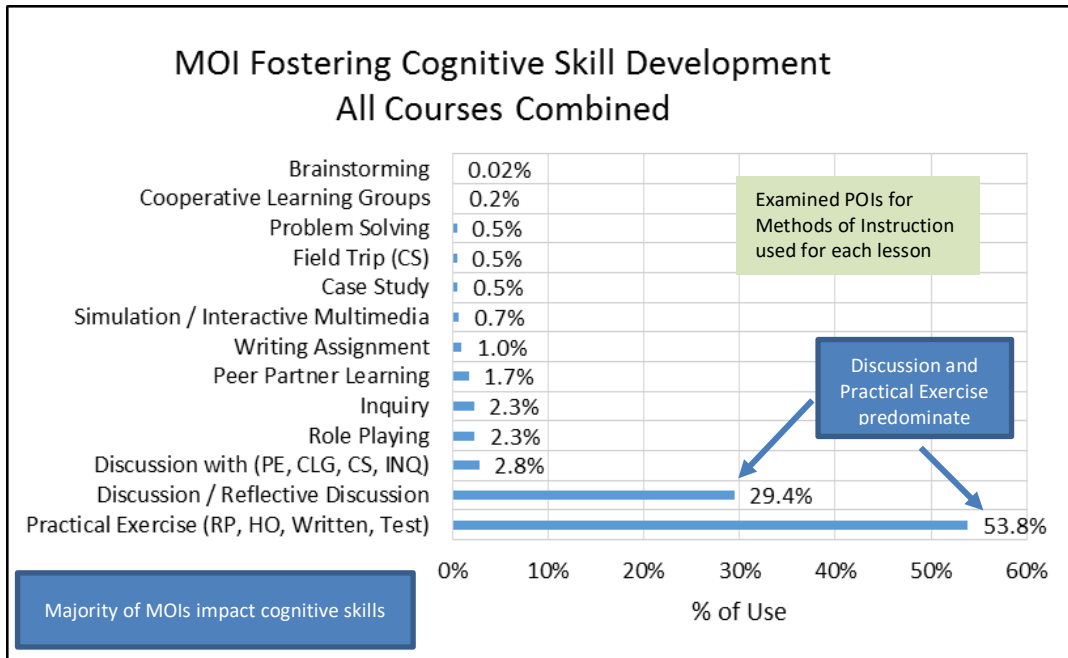


Figure 3. MOI fostering cognitive skill development

Overall, the training analysis revealed that instruction that fosters development of higher-order cognitive skills increases from those associated with lower ranks to those associated with higher ranks (see Figure 2). As expected, activities that support foundational knowledge in WOBC courses were much more associated with lower-order cognitive levels. While activities that support higher-order cognitive skill development increased somewhat in WOAC courses, there was a noticeable jump in emphasis when moving from WOAC to senior level courses. POIs frequently indicated multiple MOIs in support of cognitive skill development when instruction focused on discussions and practical exercises (83% of the time). While specific instructional skills used were not available for analysis, previous research involving ADA trainers indicated that many were not aware of instructional skills that foster critical thinking and cognitive skill development or the ways in which they could incorporate instructional skills into training (Stallings, Graves, & Blankenbeckler, 2017).

### Training Gap Analysis

Following the requirements and training analysis, the research team conducted a gap analysis to determine the presence of any gaps between the cognitive requirements of ADA WOs as they increase in rank and the training that helps prepare them to meet those requirements. The requirements analysis revealed that ADA WOs perform inherently complex duties requiring higher-order cognitive function in performance of their duties. These duties increase in scope and complexity as they advance in rank and assignment. The ADA community can expect, on average, 17% of their WOs to be serving in duty positions above their current rank.

Training that centers specifically on the development of the cognitive skill requirements for a particular grade potentially ignores the requirements for WOs to function in duty positions associated with higher ranks. The timing by which ADA WOs attend courses generally aligns

with a promotion. In other words, WO1s attend WOBC and are assigned to WO1 positions, when promoted to CW2, they attend WOAC and are assigned to CW2 positions, and then when promoted to CW3 (and sometimes not until promoted to CW4) they attend the senior warrant officer courses and are assigned to CW3 and CW4 positions. The consequence of this is that WO education is not emphasizing cognitive skill requirements by grade until WOs are entering a new duty position requiring those skills. It would be unrealistic to assume that all the cognitive development needed to perform duties at particular ranks could or would take place during the span of an institutional course directly before those skills are required.

This analysis identified three potential gaps in training as related to cognitive skill development. First, some newly promoted WOs may be unprepared for initial duty requirements because instruction to develop the cognitive skills did not occur until directly before they required the skills. Second, existing in-course cognitive skill training cannot address the 17% of WOs who reported being in duty positions above their grade. Third, trainers may not be effectively using instructional skills that foster critical thinking and cognitive development at all levels of training.

## **Discussion**

The purpose of this research was to identify the critical cognitive skills needed in the performance of ADA WO assignments, determine the current state of ADA WO training material guidelines that promote the development of cognitive skills, determine if training gaps exist, and offer mitigation strategies to bridge the gap between training provided and training required. Active duty 140A and 140E ADA WOs in grades WO1 through CW4 identified the critical cognitive skills needed by ADA WOs to perform duties at various points in their careers. Researchers gained insight into the training ADA WOs receive by reviewing training curricula, examining course POIs, and surveying WOs.

The cognitive skill requirements survey revealed that WO1 through CW4 ADA WOs indicated a need for development of higher-order thinking skills to perform duties associated with their jobs. These duties increase in scope and complexity as WOs advance in rank and assignment. Findings indicate that while decision-making, planning, and predicting are all required cognitive skills of ADA WOs, decision-making and planning are most prominent. In addition, 17% of ADA WOs operate above grade-level; therefore, it is crucial to ensure higher-order thinking skills are developed and emphasized throughout the formal education process.

Overall, the training summary analysis indicated that the activities provided in the POIs complement the intended training objective and the MOIs used are compatible with development of cognitive skills. However, in many instances, trainers may not be aware of instructional skills that complement existing training and promote critical thinking to increase cognitive development.

## **Recommendations**

Training and educational approaches should be selected based on the cognitive requirements of anticipated future WO job tasks and duties. WOs at all grades are expected to

perform critical tasks using higher-order cognitive skills, yet cognitive skill development as seen in lesson plan descriptions in current POIs are largely focused on requirements needed at ranks in the immediate future. This approach does not fully encompass the need for cognitive development over time to better prepare WOs before entering duties where specific skills are required or for the likelihood that they may be required to perform duties above grade. To evaluate this apparent shortfall further, an in-depth curricula assessment should be conducted to ensure that both the lesson activities and MOIs are appropriate for meeting the lesson objectives. LOs and appropriate instructional skills should work in tandem to support the development of higher-order thinking skills earlier in training in anticipation of increasingly complex duty requirements.

Adjustments made to POIs to increase cognitive skill development should be introduced using the ADDIE process. In the ADDIE process, training goals and objectives are established to target specific cognitive skills, whereas the instructional design establishes learning objectives to target the most suitable cognitive learning level. Leveraging the ADDIE process enables curriculum developers to modify the instructional methods used in the course to better support the desired cognitive skill development outcomes.

The next POI review and update include a revision of doctrine and TTPs for decision-making and planning processes, as well as the inclusion of additional practical exercises for both these skills. This research found that decision-making and planning skills are predominate cognitive skills used by ADA WOs. Including additional decision-making and planning skill development in the curricula may better prepare WOs for both current and future assignments. Additionally, during the POI review, course managers and training developers should ensure there is alignment in the verb usage between task item and standards. When appropriate, lesson plans should utilize MOIs that foster the development of higher-order thinking skills regardless of the cognitive level of the verb in the task item.



## References

- Anderson, L.W. (Ed.), Krathwohl, D.R. (Ed.), Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives* (Complete edition). New York: Longman.
- Bloom, B.S. (Ed.), Engelhart, M.D., Furst, E.J., Hill, W.H., & Krathwohl, D.R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain*. New York: David McKay.
- Blue, S. N., Graves, T. R., & Cobb, M. G. (2016). *Examination of air defense artillery warrant officer duties and training*. Unpublished briefing materials and data tables presented to the U.S. Army Air Defense Artillery School by the U.S. Army Research Institute, Fort Benning, GA.
- Nokes-Malach, T. J., Richey, J. E., & Gadgil, S. (2015). When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review*, 27, 645-656.
- Stallings, G. M., Graves, T. R., & Blankenbeckler, P. N. (2017). *What do trainers need to know to train higher-order thinking skills?* (Research Report 2010). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
- U.S. Department of the Army (2014a). *Army training and leader development* (TRADOC Regulation 350-1). Washington DC: Headquarters, U.S. Department of the Army.
- U.S. Department of the Army (2014b). *Commissioned officer professional development and career management* (DA Pamphlet 600-3). Washington DC: Headquarters, U.S. Department of the Army.
- U.S. Department of the Army (2016). *The Army warrant officer 2025 strategy*. Washington DC: Headquarters, U.S. Department of the Army.
- U.S. Department of the Army Training and Doctrine Command (2013). *Army educational processes pamphlet* (TRADOC Pamphlet 350-70-7). Ft. Eustis, VA: U.S. Department of the Army Training and Doctrine Command.
- U.S. Department of the Army Training and Doctrine Command (2012). *Training development in support of the operational domain* (TRADOC Pamphlet 350-70-1). Ft. Eustis, VA: U.S. Department of the Army Training and Doctrine Command.
- U.S. Department of the Army Training and Doctrine Command (2015). *Training and education development in support of the institutional domain pamphlet* (TRADOC Pamphlet 350-70-14). Ft. Eustis, VA: U.S. Department of the Army Training and Doctrine Command.

U.S. Department of the Army Training and Doctrine Command (2017). *The United States Army learning concept for training and education*. (TRADOC Pamphlet 525-8-2). Fort Eustis, VA: Department of the Army, Training and Doctrine Command.

## ACRONYMS

ADA	Air Defense Artillery
ADA WO	Air Defense Artillery Warrant Officer
ADDIE	Analysis, Design, Development, Implementation, and Evaluation
AMD	Army Air and Missile Defense
BDE	Brigade
CMF	Career Management Field
CW(2,3,4,5)	Chief Warrant Officer(2,3,4,5)
LO	Lesson Objective
LP	Lesson Plan
MOI	Method of Instruction
MOS	Military Occupational Specialty
PME	Professional Military Education
POI	Program of Instruction
TOE	Table of Organization and Equipment
TRADOC	Training and Doctrine Command
US	United States
WO(1)	Warrant Officer(1)
WOAC	Warrant Officer Advance Course
WOBC	Warrant Officer Basic Course
WOILE	Warrant Officer Intermediate Level Education
WOSSE	Warrant Officer Senior Service Education

## APPENDIX A

### DATA COLLECTION PROTOCOLS

<b>Duty Position Example</b>	140A ___ 140E_X_ For 140E were your duties Primarily Tactical ____, Primarily Technical ___ or Both Equally __X__ (mark choices with an X)
What rank were you when you entered the position? (mark with an X) WO1___ CW2_X_ CW3___ CW4___ CW5___	Years / Months in Duty Posn: yrs_3_ mos_1_
What rank were you when you left the position? (Mark with an X) WO1___ CW2___ CW3_X_ CW4___ CW5___ NA___	Years / months since leaving duty posn: yrs_2_ mos_2_ NA___
What was the defined/designated rank for your position based on the Army Manning Document? (mark with an X) WO1___ CW2___ CW3_X_ CW4___ CW5___	Where is your position within the ADA organizational and command structure? ADA BTRY___ ADA BN_X_ ADA BDE___ AAMDC___ DIV___ CORPS___ JOINT CMD___ FCoE___ Other _____

Task Category	Cognitive Skill	Cognitive Demands	
Choose One (1): Place an "X" in the task category most critical to your successful performance in this duty position	Choose One (1): Place an "X" next to the cognitive skill set most critical in performing this task category	For the Cognitive Skill set you selected in the previous question rate the below factors according to how much they impacted the cognitive skill set you selected.	
Monitoring and Supervising Operations and/or Personnel	Decision Making	Routine Daily	Mental Demand
Advising and Providing Expertise and/or Providing Leadership		Management & Supporting	Low
Coordinating Activities and/or Managing Personnel or Resources		Long Range Major	Time Demand
X	Planning	Routine Daily	Performance
Conducting Operations and Implementing Procedures		Management & Supporting	Good
Instructing/ Training Personnel and/or Evaluating Operations		Long Range Major	Effort
Planning, Developing, and/or Organizing Operations and Policy/Procedures	Predicting	Short Term	Frustration Level
		Long Term	Low

**Participant Code: EXAMPLE**

Task Category	Cognitive Skill	Cognitive Demands	
Choose One (1): Place an "X" in the task category 2nd most critical to your successful performance in this duty position	Choose One (1): Place an "X" next to the cognitive skill set most critical in performing this task category	For the Cognitive Skill set you selected in the previous question rate the below factors according to how much they impacted the cognitive skill set you selected.	
Monitoring and Supervising Operations and/or Personnel	Decision Making	Routine Daily	Mental Demand
Advising and Providing Expertise and/or Providing Leadership		Management & Supporting	Low
Coordinating Activities and/or Managing Personnel or Resources		Long Range Major	Time Demand
X	Planning	Routine Daily	Performance
Conducting Operations and Implementing Procedures		Management & Supporting	Good
Instructing/ Training Personnel and/or Evaluating Operations		Long Range Major	Effort
Planning, Developing, and/or Organizing Operations and Policy/Procedures	Predicting	Short Term	Frustration Level
		Long Term	Low

**Participant Code: EXAMPLE**

1. How long did it take you to feel that you were proficient in accomplishing the tasks in the task categories you selected?  
Task Category 1: Years \_\_\_\_\_ Months \_\_\_\_\_  
Task Category 2: Years \_\_\_\_\_ Months \_\_\_\_\_
  
2. Why did you select the **Task Categories** as the **most critical**?  
Task Category 1: \_\_\_\_\_  
Task Category 2: \_\_\_\_\_
  
3. What was the primary reason or factor that led to the **most critical Cognitive Skill** you selected for the two task categories?  
Task Category 1: \_\_\_\_\_  
Task Category 2: \_\_\_\_\_
  
4. What was the primary reason or factor that led to the ratings you gave for **Cognitive Demands**?  
Task Category 1: \_\_\_\_\_  
Task Category 2: \_\_\_\_\_
  
5. How did the **Cognitive Demands** required for performing tasks in these categories change as you gained experience in the duties assigned?  
Task Category 1: \_\_\_\_\_  
Task Category 2: \_\_\_\_\_

*Figure A-1: Example Survey*

## APPENDIX B

### COGNITIVE LEVELS OF VERBS

#### Army Approved Standard Verb for Task Titles

Approved verbs	C verb level	Related verbs
Access	C2	collect, request, locate, enter
Administer	C3	apply, conduct, control, deliver, direct, distribute, extend, issue, perform, provide
Analyze	C4	determine, evaluate, inspect, interpret, resolve, test
Annotate	C2	define, interpret
Apply	C3	administer, connect, direct, employ, engage, place, request, turn
Approve	C4	establish, maintain, validate
Assemble	C5	collect, connect, construct, erect, produce, set up
Assess	C6	check, determine, evaluate
Brief	C2	inform, orient, prepare, update
Calculate	C3	adjust, compute, determine
Challenge	C2	cross, test
Change	C3	adjust, displace, exchange, modify, reduce, remove, reorganize, replace, resolve, translate, transmit, turn
Check	C1	analyze, compare, confirm, control, correct, inspect, monitor, prevent, read, reduce, review, test, verify
Communicate	C2	connect, inform, publish, report, transmit
Compare	C4	analyze, connect, correlate, inspect, observe
Compute	C3	calculate
Conduct	C3	administer, control, direct, lead, operate, order, organize
Confirm	C2	correlate, establish, validate, verify
Consolidate	C5	develop
Control	C3	administer, adjust, check, collect, conduct, direct, lead
Coordinate	C4	adjust, correlate, integrate, organize
Correlate	C4	compare, connect, coordinate
Counsel	C5	direct, inform, order, recommend
Debrief	C2	notify, report, review
Deconflict	C5	
Defend	C6	guard, maintain, prevent, protect, recommend
Define	C1	designate, determine, establish, interpret, translate
Demonstrate	C3	confirm, determine, establish, test, validate
Designate	C5	define, select
Detect	C1	observe, recognize
Determine	C6	complete, check, demonstrate, detect, establish, move, resolve, verify
Download	C1	
Draft	C4	plan, prepare, project
Edit	C4	assemble, prepare, refine
Employ	C3	apply, engage, occupy, operate
Ensure	C2	confirm, establish, guard, infiltrate, open, post, protect, provide
Establish	C5	confirm, demonstrate, determine, erect, install, land, organize, place, provide, verify

Estimate	C2	evaluate, predict
Evaluate	C6	assess, check
Facilitate	C3	administer, collect, conduct, coordinate, manage, move, organize, orient, present, train
Identify	C1	analyze, determine, establish, place, recognize, select
Implement	C3	complete, enforce, perform, resolve
Inform	C2	brief, communicate, notify, post, update
Integrate	C5	consolidate, coordinate, organize
Interpret	C2	annotate, define, perform, read, translate
Investigate	C2	
Lead	C3	conduct, direct, guard, move, protect, produce
Localize	C4	
Locate	C1	detect, determine, establish, place, position, read
Manage	C3	administer, conduct, control, counsel, designate, direct, maintain, operate, request, train
Modify	C5	adjust, change, correct, reorganize, repair, revise, turn
Order	C3	adjust, align, conduct, control, direct, distribute, engage, establish, locate, obtain, organize, place, plan, request
Organize	C5	adjust, construct, coordinate, establish, set up
Orient	C1	adjust, align, determine, direct, locate, turn
Perform	C3	complete, move, observe, operate, react
Plan	C5	calculate, organize, prepare, project
Predict	C4	read
Prepare	C3	adjust, assemble, construct, develop, plan, produce, provide
Present	C2	brief, debrief, demonstrate, inform, orient, perform, report
Process	C3	prepare, treat
Produce	C3	assemble, construct, deliver, develop, direct, perform, provide
Project	C5	calculate, draft, plan, predict, extend, launch, transmit
React	C3	counter, operate, perform
Read	C2	interpret, translate
Recognize	C1	observe, place, verify
Recommend	C5	confirm, counsel
Reconnoiter	C1	analyze, review
Record	C1	enter, post, report, store, designate, read
Refine	C3	adjust; align, configure, correct, repair, revise
Register	C2	enter, record
Reorganize	C4	adjust, correct, modify, reduce
Report	C2	communicate, debrief, inform, notify, publish, record
Request	C2	apply
Resolve	C4	analyze, determine
Review	C2; C6	analyze, assess, correct, debrief, inspect, revise
Revise	C5	change, compare, develop, modify, reorganize, review, update,
Schedule	C5	engage, organize, plan, record, set-up
Secure	C4	adjust, defend, ensure, guard, obtain, protect
Select	C1	
Task	C6	load
Test	C4	analyze, assess, check, confirm, demonstrate, validate, verify
Translate	C2	change, interpret, turn
Troubleshoot	C4	adjust, align, connect, correct, repair
Update	C5	revise

Validate	C4	confirm, verify
Verify	C4	check, confirm, demonstrate, establish, test, validate
Write	C1	mark, register

---

*Note. Adapted from TRADOC Pamphlet 350-70-14 (2015)*



## APPENDIX C

### TRAINING SUMMARY RESULTS

#### Command and Control Systems Integrator, WOBC (Course Number: 4F-140A)

**Curriculum summary.** Command and Control Systems Integrator, WOBC (Course Number: 4F-140A) trains newly appointed active and reserve WOs in the operation and joint services integration of the Army Air and Missile Defense Systems and their associated equipment. Table D-1 lists the course modules and associated hours of instruction.

Table D-1  
*WOBC (Course Number: 4F-140A) Course Summary*

Module	Module Title	Module Hours
A	Common Core	68.3
B	Multi-TDL Advanced Interoperability	71.0
C	LAN / Networking	68.4
D	Introduction to Generators and Shelter Maintenance Management	26.2
E	System Administration and Integration	140.4
F	Voice and Data Systems Communications	114.4
G	AMD Systems Integration	108.4
	Total Academic Learning Hours	597.0
	Administrative Time	171.0
	Test Time	102.8
	Total Course Hours	871.0

**Targeted higher-order cognitive skills summary.** Table D-2 depicts the percentage breakdown of the WOBC (140A) higher-order cognitive skills (module/lesson/task level), MOI and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 37.7 of 597 (6.3%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in four of the seven academic modules.

Table D-2  
*WOBC (4F-140A) Modules/Lessons Higher-Order Cognitive Learning*

Module	Module Title	Lesson Title	Action Text/Objective	Cognitive Verb Level	Higher-Instruction Level (HL) Hours	% Course Academic Hours	MOI
B	Multi-TDL Advanced Interoperability	OPTASKLINK Comprehension Lab	Develop an exercise	C6	4.0	0.67%	Practical Exercise (PE)
		OPTASKLINK Validation Lab	Validate the exercise				

		Individual Architecture Lab	Develop a unit's portion of the Link Architecture.	C6	4.0	0.67%	PE
		Group Architecture Lab	Develop a Task Force's Link Architecture.	C6	4.0	0.67%	PE
		End of Module (EoM) Critique	Perform an EoM critique	C4	2.0	0.33%	Critique/After Action Review (AAR)
C	LAN/Networking	Intro to Networking	Interpret Local Area Network (LAN)	C-5	5.2	0.87%	Reflective Discussion & Simulation (SIM)
F	Voice And Data Communications	AN/PRC-150 Voice/Data Communications	Integrate the AN/PRC 150 Radio	C5	10.5	1.75%	Reflective Discussion, Exercise, & SIM
G	AMD Systems Integration	Overview of Army Air and Missile Defense (AMD) Organizations	Army Air and Missile Defense (AMD) Organizations.	C4	4.0	0.67%	Discussion
				<b>TOTAL</b>	<b>37.7</b>	<b>6.30%</b>	

*Note.* The total academic hours come from Table D-1. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-3 depicts the percentage breakdown of the WOBC (140A) MOI at the course level. The MOIs most heavily used in higher-order cognitive learning are practical exercise at 3.77%, then discussion / reflective discussion at 1.88%, and simulation / interactive multimedia at .67% . Testing of higher-order cognitive skills is incorporated in the practical exercises.

Table D-3  
*WOBC (140A) Method of Instruction at the Course Level*

Method of Instruction for WOBC 140A Course	Percentage of Academic Hours
Practical Exercises (RP, HO, Written, Test)	3.77%
Discussion /Reflective Discussion	1.88%
Simulation /Interactive Multimedia	0.67%

\* The percentages reflect the percentage of MOI use within the full POI. Academic hours include higher-order hours and exclude administrative hours.

### **Patriot System Technician, WOBC (Course Number: 4F–140E)**

**Curriculum summary.** Patriot System Technician WOBC (Course Number: 4F–140E) provides tactical, technical, and leadership training to Air and Missile Defense (AMD) WOs in order to support the Operational Force (OF) in an Operating Environment (OE). The course focuses on the tactical, technical, operational, and management aspects of the Patriot Missile System. Table D-4 lists the course modules and associated hours of instruction.

Table D-4  
 WOBC (Course Number: 4F-140E) Course Summary

Module	Module Title	Module Hours
A	Patriot System Operations - Table I	22.4
B	Patriot System Operations - Table II	47.9
C	Patriot System Operations - Table III	23.2
D	Patriot System Operations - Table IV	58.6
E	Logistics Support	76.4
F	Engagement Control Station (ECS) Maintenance	249.2
G	Radar Maintenance	366.0
H	Launching Station Maintenance	150.2
I	Comprehensive Maintenance and Update	3.7
J	Common Core	31.0
	Total Academic Learning Hours	1028.6
	Administrative Time	213.9
	Test Time	259.4
	Total Course Hours	1502.0

**Targeted higher-order cognitive skills summary.** Table D-5 depicts the percentage breakdown of the WOBC (140E) higher-order cognitive skills (module/lesson/task level), MOI and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 55 of 1028 (5.35%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in three of the ten academic modules.

Table D-5  
*WOBC (4F-140E) Lessons and Associated Higher-Order Cognitive Learning*

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course Academic Hours	MOI
B	Patriot System Operations - Table II	TCO Responsibilities	Perform Duties and Responsibilities as the	C4	5	0.04%	PE (hands-on) & Discussion
			TCO				
C	Patriot System Operations - Table III	MDMP to TABS (IPB)	Perform MDMP to TABS process against TBMS,SBTS, and	C6	2	0.02%	Discussion/ Reflective
			Missile Threats				
F	ECS Maintenance	AAR	Critique Table IV	C5	1	0.01%	Discussion
			Introduction To Electronics DC Circuits	Determine DC circuit parameters	C5	18	0.17%
		Introduction To Electronics AC Circuits	Determine Parameters for alternating Current (AC) circuits	C5	18	0.17%	PE & Discussion
		On-Line Maintenance Information	Interpret Patriot on line equipment fault indicators using the Fire Platoon Status Monitor (FPSM)	C4	10	0.09%	PE & Discussion
		AAR	Critique the Course	C5	1	0.01%	Discussion
				TOTAL	55	5.35%	

*Note.* The total academic hours come from Table D-4. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-6 depicts the percentage breakdown of the WOBC (140E) MOI at the course level. The MOIs used in higher-order cognitive learning are practical exercise at 2.82% and discussion / reflective discussion at 2.53%. Testing of higher-order cognitive skills is incorporated in the practical exercises.

Table D-6  
*WOBC (140E) MOI at the Course Level*

Method of Instruction for WOBC 140E Course	Percentage of Academic Hours
Practical Exercises (RP, HO, Written, Test)	2.82%
Discussion /Reflective Discussion	2.53%

\*The percentages reflect the percentage of MOI use within the course overall. Academic hours include higher-order hours only and exclude non-academic, administrative hours.

**ADA WOAC (Course Number: 2-44-C32-140A)**

**Curriculum summary.** ADA WOAC (Course Number: 2-44-C32-140A) educates, trains and prepares Air Defense Artillery (ADA) Warrant Officers MOS 140A to lead and manage operations in complex geopolitical environments worldwide. Table D-7 lists the course modules and associated hours of instruction.

Table D-7  
WOAC (Course Number: 2-44-C32-140A) Course Summary

Module	Module Title	Module Hours
A	Course Introduction	19.7
B	ADC4I System Operations	75.0
C	Multi-TDL Operations and Planning	79.0
D	Systems Integration	92.0
Total Academic Hours		265.7
Administrative Time		66.1
Test Time		8.3
Total Course Hours		340.0

**Targeted higher-order cognitive skills summary.** Table D-8 depicts the percentage breakdown of the WOAC (140A) higher-order cognitive skills (module/lesson/task level), MOI, and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 59.1 of 265.7 (22.24%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in three of the four academic modules.

Table D-8  
WOAC (140A) Lessons and Associated Higher-Order Cognitive Learning

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course Academic Hours	MOI
B	ADC4I System Operations	ADAM Cell Capabilities and Limitations	Determine the capabilities and limitations of the ADAM Cell for participation in the Joint Data Network (JDN).	C5	2	0.75%	Discussion/ Reflective
		Patriot Digital Information Link (PADIL)	Evaluate the characteristics of the Patriot Digital Information Link (PADIL) Protocol.	C6	2	0.75%	Discussion/ Reflective
		SADL Multi-TDL	Analyze the characteristics of the Situational Awareness Data Link (SADL) Protocol.	C4	2	0.75%	Discussion/ Reflective
C	Multi-TDL Operations And Planning	Network Planning Considerations	Interpret the required considerations needed to support MTN architecture planning	C6	4	1.50%	PE, Brain Storming (BR) & Discussion

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course Academic Hours	MOI
		Training Environment	Conduct Tactical Data Link (TD) Planning	C6	35	13.20%	PE, Discussion/ Reflective
		Network Description Document	Determine the different sections of a Network Description Document (NDD), how the NDD depicts the data in a Network Design Load (NDL), and how that data is modified by the user at load time.	C6	4	1.50%	Discussion/ Reflective & PE
		Data Extraction and Reduction	Determine data that is displayed in the Data Extraction and Reduction Guide (DERG) format	C5	1.1	0.41%	Discussion/ Reflective & PE
		Cryptographic Systems	Determine Cryptographic requirements needed for operation on the JDN	C5	1	0.37%	Discussion/ Reflective
D	Systems Integration	Training Environment TDL Planning Briefing	Produce operational products/material conduct TDL planning, design network architecture, generate OPTASK Link, conduct briefing, and execute plan	C6	8	3.00%	Discussion/ Reflective & PE
				TOTAL	59.1	22.24%	

*Note.* The total academic hours come from Table D-7. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-9 depicts the percentage breakdown of the WOAC (140A) MOI at the course level. MOIs most heavily used in higher-order cognitive learning are practical exercise at 17.46%, discussion /reflective discussion at 4.59%, and brainstorming at .19%. Testing of higher-order cognitive skills is incorporated in the practical exercises.

Table D-9  
*WOAC (140A) Method of Instruction at the Course Level*

Method of Instruction for WOAC 140A Course	Percentage of Academic Hours
Practical Exercises (RP, HO, Written, Test)	17.46%
Discussion /Reflective Discussion	4.59%
Brainstorming	0.19%

\* The percentages reflect the percentage of MOI use within the full POI. Academic hours include higher-order hours and exclude administrative hours.

**ADA WOAC, (Course Number: 2-44-C32-140E)**

**Curriculum summary.** ADA WOAC, (Course Number: 2-44-C32-140E) focuses on Army Integrated Air and Missile Defense (AIAMD) technical knowledge required to perform in

WO duty positions at the Patriot Battalion, Terminal High Altitude Area Defense (THAAD) Battery, and AN/TPY-2 Forward-Based Mode (FBM) Missile Defense Detachments as Standardization Officers, Tactical Directors, and Operations Support Technicians. Table D-10 lists the course modules and associated hours of instruction.

Table D-10

WOAC, (Course Number: 2-44-C32-140E) Course Summary

Module	Module Title	Module Hours
A	Leader Development	50.6
B	Inter-Operability	19.6
C	Patriot Operations	76.6
D	AMD Capabilities and Limitations	20.6
E	Defense Design	78.0
	Total Academic Hours	245.4
	Administrative Time	90.0
	Test Time	30.6
	Total Course Hours	366.0

**Targeted higher-order cognitive skills summary.** Table D-11 depicts the percentage breakdown of the WOAC (140E) higher-order cognitive skills (module/lesson/task level), MOI and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 23 of 245.4 (9.37%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in four of the five academic modules.

Table D-11

WOAC (140E) Lessons and Associated Higher-Order Cognitive Learning

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course Academic Hours	MOI
B	Inter-Operability	Analyze Air and Missile Defense Operations	Analyze Air and Missile Defense (AMD) Operations.	C4	4	1.63%	Discussion/ Reflective
C	Patriot Operations	Analyze Patriot Tactics, Techniques and Procedures (TTPS)	Analyze Patriot Tactics, Techniques and Procedures (TTPs).	C4	4	1.63%	Discussion/ Reflective PE &
	AMD	Evaluate Patriot Air Battle Management	Evaluate Patriot Air Battle Management	C5	11	4.48%	Discussion/ Reflective
D	Capabilities And Limitations	Analyze ADA Lessons Learned	Analyze ADA Lessons Learned.	C4	2	0.82%	Discussion/ Reflective
E	Defense Design	Prevent Patriot Fratricide	Prevent Patriot Fratricide	C5	2	0.82%	Discussion/ Reflective
				TOTAL	23	9.37%	

Note. The total academic hours come from Table D-10. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-12 depicts the percentage breakdown of the WOAC (140E) MOI at the course level. The MOIs used in higher-order cognitive learning are discussion /reflective discussion at 5.70% and practical exercise at 3.67%. Testing of higher-order cognitive skills is incorporated in the practical exercises.

Table D-12

*WOAC (140E) Method of Instruction at the Course Level*

Method of Instruction for WOAC 140E Course	Percentage of Academic Hours
Discussion /Reflective Discussion	5.70%
Practical Exercises (RP, HO, Written, Test)	3.67%

\* The percentages reflect the percentage of MOI use within the full POI. Academic hours include higher-order hours and exclude administrative hours.

**WOILE (Course Number: 1-250-C8)**

**Curriculum summary.** WOILE (Course Number: 1-250-C8) focuses on staff skills, training doctrine, force integration, leader development, unified land operations, Joint, Interagency, Intergovernmental, and Multinational (JIIM) operational environment, insurgency, counterinsurgency, creative thinking, and critical thinking techniques. Table D-13 lists the course modules and associated hours of instruction.

Table D-13

*WOILE (Course Number: 1-250-C8) Course Summary*

Module	Module Title	Module Hours
A	Education-WOILE Phase2	175
B	Mandatory-WOILE Phase2	11
	Total Academic Hours	186
	Administrative Time	16
	Test Time	6
	Total Course Hours	208

**Targeted higher-order cognitive skills summary.** Table D-14 depicts the percentage breakdown of the WOILE higher-order cognitive skills (module/lesson/task level), MOI and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 119 of 186 (63.98%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in both of the academic modules.

Table D-14

*WOILE Lessons and Associated Higher-Order Cognitive Learning*

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course (Academic only)	MOI
--------	--------------	--------------	-------------	----------------------	----------------------	--------------------------	-----



A	Education-WOILE Phase2	Global Trends and Challenges	Analyze international globalization effects upon economic and military environments.	C4	3	1.61%	Inquiry
		The Operational Environment	Analyze warfighting enablers within the Operational Environment.	C4	4	2.15%	Inquiry
		Operational Environment Assessment, Political, Military, Economic, Social Infrastructure, Information, Physical Environment and Time.	Analyze warfighting enablers within the Operational Environment.	C4	4	2.15%	Inquiry
		(PMESII-PT) Project Management for Warrant Officers	Conduct Operational planning, management, and execution as a staff officer	C6	18	9.67%	Role Playing
		Knowledge Management for Warrant Officers	Apply knowledge management to operational planning, management, and execution as a staff officer	C4	12	6.45%	Role Playing
		Information Operations Leadership	Analyze information operations doctrine.	C4	2	1.07%	Inquiry
		Research and Writing	Write a research paper on a leadership topic	C4	3	1.61%	Writing Assignment
		Power and Influence	Analyze how warrant officers lead in the development of organizations and leaders to achieve results.	C4	2	1.07%	Discussion w/ PE
		Professional Military Ethics	Evaluate senior Warrant Officer ethical leadership responsibilities and functions	C6	2	1.07%	Discussion w/ PE
		Building Teams	Analyze how leaders build teams.	C4	2	1.07%	Discussion w/ PE
		Negotiation	Analyze how leaders negotiate to extend influence within and beyond the chain of command.	C4	2	1.07%	Discussion w/ PE

Developing Learning Organizations US Army Operations Doctrine Review	Analyze how warrant officers lead in the development of organizations and leaders to achieve results.	C4	1	0.53%	Inquiry
Decisive Action-Offense	Analyze the U.S. Army's operational doctrine.	C4	1	0.53%	Discussion/ Reflective
Decisive Action-Defense	Analyze U.S. Army Offensive Operations doctrine.	C4	2	1.07%	Discussion w/PE
Decisive Action-Stability Operations Defense Support of Civil Authorities (DSCA)	Analyze US Army doctrine for the fundamentals of the defense.	C4	2	1.07%	Discussion/ Reflective
U.S. Army Sustainment Doctrine Overview	Analyze US Army Stability Operations doctrinal concepts.	C4	2	1.07%	Discussion w/PE
MDMP Review & Application	Analyze US Army doctrine for Defense Support of Civil Authorities.	C4	4	2.15%	Role Playing
Study of Military History	Analyze the US Army Sustainment doctrinal concepts.	C4	2	1.07%	Inquiry
Insurgency and Characteristics of Insurgency Network (COIN)	Conduct operational planning, management, and execution as a staff officer	C4	8	4.30%	Role playing
Decisive Battles	Analyze the importance of studying military history.	C4	3	1.61%	Discussion w/PE
Battle of Horse Shoe Bend (HSB) Overview	Analyze insurgencies with an emphasis on threads of continuity (past as prologue)	C4	3	1.61%	Discussion w/PE
Battle of Horse Shoe Bend (HSB) Overview	Analyze decisive battles.	C4	3	1.61%	Discussion w/PE
Horse Shoe Bend Staff Ride	Conduct a Battle Analysis of the Battle of Horse Shoe Bend, AL.	C4	8	4.30%	Inquiry
Horse Shoe Bend Staff Ride	Conduct a staff Ride for the Battle of Horse Shoe Bend, AL	C4	12	6.45%	Field Trip

			Conduct operational planning, management, and execution as a staff officer in a small group environment	C4	10	5.37%	Role Playing	
B	Mandatory- Phase 2	WOILE	Media Relations	Analyze the impact of military-media relations on military operations.	C4	2	1.07%	Discussion/ Reflective
			Operational Law- Law of War	Analyze operational legal issues and Law of War.	C4	2	1.07%	Discussion/ Reflective
				TOTAL	119	63.98%		

*Note.* The total academic hours come from Table D-13. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-15 depicts the percentage breakdown of the WOILE (1-250-C8) MOI at the course level. The MOIs most heavily used in higher-order cognitive learning are role playing at 27.96 %, then inquiry at 12.90%, and discussion w/practical exercise at 11.29%. No testing time is assigned for higher-order skills; however, Sabre Strike—an eight-hour capstone exercise using the Military Decision Making Process (MDMP) during a simulated operation—integrates lower- and higher-order cognitive skill learning.

Table D-15  
*WOILE Method of Instruction at the Course Level*

Method of Instruction for WOILE	Course	Percentage of Academic Hours
Role Playing		27.96%
Inquiry		12.90%
Discussion with (PE, CLG, CS, INQ)		11.29%
Field Trip (CS)		6.45%
Discussion/Reflective Discussion		3.76%
Writing Assignment		1.61%

\* The percentages reflect the percentage of MOI use within the full POI. Academic hours include higher-order hours and exclude administrative hours.

**WOSSE (Course Number: 1-250-C9)**

**Curriculum summary.** WOSSE (Course Number: 1-250-C9) prepares senior WOs with the senior level education, knowledge, and influential leadership skills necessary to apply their technical expertise in support of leaders on strategic level JIIM staffs during Unified Land Operations. Table D-16 lists the course modules and associated hours of instruction.

Table D-16  
*WOSSE (Course Number: 1-250-C9) Course Summary*

Module	Module Title	Module Hours
A	Education	145.5
B	Mandatory Topics	2.0
Total Academic Hours		147.5
Administrative Time		14.0

Test Time

Total Course Hours 8.0  
169.5

**Targeted higher-order cognitive skills summary.** Table D-17 depicts the percentage breakdown of the WOSSE higher-order cognitive skills (module/lesson/task level), MOI and percentages supporting higher-order cognitive learning compared to the overall course. Results indicate that 104.5 of 147.5 (70.85%) course academic hours are committed to lessons targeting the development of higher-order cognitive skills. Lessons targeting these skills are represented in both academic modules.

Table D-17  
*WOSSE Lessons and Associated Higher-Order Cognitive Learning*

Module	Module Title	Lesson Title	Action Text	Cognitive Verb Level	HL Instruction Hours	% Course Academic Hours	MOI	
A	Education	Army Roles and Organizations	Analyze the roles and organization of the US Army. Analyze the Actors, Goals, and Instruments, which influence conflict in a globalized environment and affect US Policy and Strategy.	C4	4	2.71%	PE	
		International Security Environment	Evaluate how military organizations transform and how broader upheavals in human affairs reshape societies and the military organizations serving those societies	C4	8	5.42%	Inquiry	
		History of Insurgency and Guerilla Warfare	Evaluate the formulation and use of national policy	C5	4	2.71%	Inquiry Discussion/ Reflective	
		Policy	Analyze elements of the operational environment and their impact on US National Interests.	C5	6	4.07%		
		Operational Environment Colonial America and the Founding of a Nation	Analyze how the relationship between civil authority and military power has evolved.	C4	10	6.76%	Inquiry	
								Discussion w/ PE
		Joint Staff Operations	Apply the Joint Operational Planning Process Detail media impacts on US military Policy, outline strategic influences offered through media sources and discuss the changing Military cultural assumptions towards the media	C6	4	8.13%	Inquiry Discussion/ Reflective w/ PE	
		Policy and Media		C4	4	2.71%	Inquiry	

	Jointness	Evaluate how the U.S. military is organized to plan, execute, sustain and train for joint, interagency, intergovernmental and multinational operations	C5	15	10.17%	Discussion w/PE Case Study & Discussion/ Reflective
	WOSSC History Staff Ride	Apply the Joint Operational Planning Process to historical analysis of decisive battles	C4	14	9.49%	Discussion/ Reflective
	Purple Hope Leadership	Conduct planning for multinational humanitarian exercise	C6	10	6.76%	PE
	Theories and Case Study Methodology	Understand and use leadership theory and the case study methodology	C4	4	2.71%	Discussion/ Reflective & PE
	Special Topics in Stewardship	Evaluate one or more special topics related to senior-leader ethical stewardship	C4	3.5	2.37%	Inquiry
	Profession of Arms - Ethics	Evaluate the effects of personal and professional values either reinforcing or being in tension with each other	C5	2	1.35%	Cooperative Learning Groups
	Guarding the Army Ethic	Evaluate the state of candor within the Army Profession at the individual and institutional level	C5	2	1.35%	Cooperative Learning Groups
B	Mandatory Risk Topics Management	Assess the impact of Risk Management (RM) on military operations.	C4	2	1.35%	Discussion w/PE
			Total	104.5	70.85%	

*Note.* The total academic hours come from Table D-16. Percentages are based on academic hours only (not administrative or testing hours).

**MOI summary.** Table D-18 depicts the percentage breakdown of the WOSSE (1-250-C9) MOI at the course level. MOIs most heavily used in higher-order cognitive learning are inquiry at 20.00%, discussion with practical exercise at 14.24%, discussion/ reflective discussion at 13.90%, and practical exercise at 12.88%. There is no testing specifically associated with higher-order skills; however, Purple Hope—a Foreign Humanitarian Assistance/Coalition-building practical, hands-on, and role-play exercise—contains both lower- and higher-order cognitive skills development in the curriculum.

Table D-18  
*WOSSE Method of Instruction at the Course Level*

Method of Instruction for WOSSE Course	Percentage of Academic Hours
Inquiry	20.00%
Discussion with (PE, CLG, CS, INQ)	14.24%
Discussion / Reflective Discussion	13.90%
Practical Exercise (RP, HO, Written, Test)	12.88%
Case Study	7.12%
Cooperative Learning Groups	2.71%

\* The percentages reflect the percentage of MOI use within the full POI. Academic hours include higher-order hours and exclude administrative hours.